

TITLE: Tidal Marsh Outwelling of Dissolved Organic Matter and resulting temporal variability in coastal water optical and biogeochemical properties.

PRESENTATION TYPE: Invited Presentation

SECTION: Interdisciplinary (IT)

SESSION: Resolving temporal scales of biological and biogeochemical variability in the sea: from hours to decades (IT42)

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Coastal wetlands are highly dynamic environments at the land-ocean interface where human activities, short-term physical forcings and intense episodic events result in high biological and chemical variability. Long being recognized as among the most productive ecosystems in the world, tidally-influenced coastal marshes are hot spots of biogeochemical transformation and exchange. High temporal resolution observations that we performed in several marsh-estuarine systems of the Chesapeake Bay revealed significant variability in water optical and biogeochemical characteristics at hourly time scales, associated with tidally-driven hydrology. Water in the tidal creek draining each marsh was sampled every hour during several semi-diurnal tidal cycles using ISCO automated samplers. Measurements showed that water leaving the marsh during ebbing tide was consistently enriched in dissolved organic carbon (DOC), frequently by more than a factor of two, compared to water entering the marsh during flooding tide. Estimates of DOC fluxes showed a net DOC export from the marsh to the estuary during seasons of both low and high biomass of marsh vegetation. Chlorophyll amounts were typically lower in the water draining the marsh, compared to that entering the marsh during flooding tide, suggesting that marshes act as transformers of particulate to dissolved organic matter. Moreover, detailed optical and compositional analyses demonstrated that marshes are important sources of optically and chemically distinctive, relatively complex, high molecular weight, aromatic-rich and highly colored dissolved organic compounds. Compared to adjacent estuarine waters, marsh-exported colored dissolved organic matter (CDOM) was characterized by considerably stronger absorption (more than a factor of three in some cases), larger DOC-specific absorption, lower exponential spectral slope, larger fluorescence signal, lower fluorescence per unit absorbance, and higher fluorescence at visible wavelengths. Observed patterns in water optical and biogeochemical variables were very consistent among different marsh systems and throughout the year, despite continued tidal exchange, implying rapid transformation of marsh DOM in the estuary through both photochemical and microbial processes. These findings illustrate the importance of tidal marsh ecosystems as sources, sinks and/or transformers of biologically important nutrients, carbon and colored dissolved organic compounds, and their influence on short-term scale biological, optical and biogeochemical variability in coastal waters.